Attorney Docket No. Q67643
PATENT APPLICATION

AMENDMENT UNDER 37 C.F.R. § 1.116
U.S. Appln. No. 10/022,896

REMARKS

Applicants thank the Examiner for acknowledging their claims to priority.

Claims 1-13 are all the claims pending in the application.

Claim 13 is allowed.

Claim 6 stands rejected under 35 U.S.C. 112, second paragraph, as being indefinite for insufficient antecedent basis. Applicants have changed the base claim of claim 6.

Claims 1-2, 7 and 12 stand rejected under 35 U.S.C. 102(e) as being anticipated by USP 6,717,963 to Foursa. Claims 1, 5, 8 and 11-12 stand rejected under 35 U.S.C. 102(e) as being anticipated by USP 6,510,000 to Onaka. Claims 1 and 9-10 stand rejected under 35 U.S.C. 102(e) as being anticipated by USP 6,657,774 to Evans. Claim 6 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 3-4 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Hecht et al. (Understanding Fiber Optics, 1993). Applicants respectfully traverse these rejections, and request reconsideration and allowance of the claims in view of the following arguments.

Claim 1 recites a wide bandwidth Raman amplifier including a laser pump source for producing a wideband pump radiation signal having a plurality of different radiation wavelengths, and means for adjustable independent power control of each of the plurality of different radiation wavelengths of said wideband pump radiation signal. However, none of the references teaches or suggests means for adjustable independent power control of each of the

plurality of different radiation wavelengths of a wideband pump radiation signal produced by a single laser pump source.

As discussed in the Background section of the present application, a conventional Raman amplifier using a single pump wavelength has a gain profile that is far from flat. Amplifiers operating over a range of wavelengths have improved flatness of gain profile, but a conventional Raman amplifier using more than one pump source has cost, size and complexity problems. Thus, the purpose of the present application is to provide a gain flattened Raman amplifier including a laser source for producing a wideband pump radiation signal, wherein the power of each of a plurality of different radiation wavelengths of the wideband pump radiation signal is independently adjustable.

As shown in Fig. 2 of the present application, a coupler 24 couples pump radiation from a single pump 20 to a plurality of variable optical attenuators 26, 28, 30 and 32. Each of the optical attenuators 26-32 is associated with a respective reflector 34, 36, 38 and 40. Each of the optical attenuators produces reflected radiation of different wavelengths $\lambda 1$, $\lambda 2$, $\lambda 3$, and $\lambda 4$. The amount of reflection radiation provided by each reflector is controlled by each of the respective available optical attenuators 26-32. The combined resulting reflection radiation is then provided to a transmission fiber 2 for Raman amplification. Thus, a single pump 20 is used to produce pump radiation of substantially wide bandwidth, including $\lambda 1$, $\lambda 2$, $\lambda 3$, and $\lambda 4$, and the power of each of the wavelengths is independently adjustable.

1. Foursa

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The Examiner has asserted that Foursa teaches the invention of claims 1-2, 7 and 12, referring to Figs. 4 and 7, and col. 3, lines 55-60 of Foursa. Applicants respectfully disagree.

Foursa provides a Raman fiber amplifier using a wide bandwidth continuous wave (CW) pump. As described at lines 45-55 of column 3 of Foursa, a wide bandwidth pump source 320 may comprise a plurality of wide bandwidth pump sources, and if so, the resulting power spectrum can be controlled by readjustment of the electrical power of individual pump outputs used with spectrum shaping filters 322 at the output of the combined pump source. Thus, Foursa adjusts the signal power pump by pump, but does not teach or suggest independently adjusting individual radiation wavelength components of the output from a single pump, as is recited in the claims of the present application. While the Examiner has referred to Fig. 5 as illustrating a single pump, there is no disclosure of independently adjusting individual radiation wavelength components of the output of the pump in Fig. 5. Instead, it is an example of a pump that can be used in the Foursa arrangement, and if several such pumps are used as described at lines 5-55 of column 3, then the output of each such pump can be adjusted. Again, however, there is no discussion of independently adjusting individual radiation wavelength components of the output from a single pump.

Thus, Applicants respectful submit that claims 1-10, 11 and 12 are patentable over Foursa.

2. Onaka

The Examiner has asserted that Onaka teaches the invention of claims 1, 5, 8, and 11-12, referring to Fig. 9, and col. 15, lines 25-35. Applicants respectfully disagree.

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Onaka provides an optical amplifier for wide band Raman amplification of wavelength division multiplexed signal lights. As shown in Figs. 1, 4, 6-9, 10E, 11-14, 17-20, 23-24, the Onaka amplifier has a plurality of light sources, each emitting light at a certain wavelength. These light sources are excitation light sources, not pump sources, so there is clearly no anticipation of any of the present claims. Further, they are separate sources, and as a result Onaka is at most analogous to the conventional Raman amplifier that uses more than one pump source to produce a wideband wavelength pump radiation. However, as mentioned in the Background section of the present application, such an approach is unfavorable because of the problem of cost, size, and complexity for the amplifier.

The pump source of the amplifier shown in Fig. 14 of Onaka has excitation light source units 601 and 603. The excitation light source unit 601 has light sources 81 and 82 emitting light having wavelength $\lambda 1$ and $\lambda 2$ respectively, fiber grating filters 51 and 52, and a polarization coupler 6 multiplexing light from light sources 81 and 82. The excitation light source unit 603 has light sources 85 and 86 emitting light having wavelength $\lambda 3$ and $\lambda 4$ respectively, fiber grating filters 55 and 56, and a polarization coupler 63 multiplexing light from light sources 85 and 86. A WDM coupler 23 multiplexes light from the coupler 6 and the coupler 63. A control unit 2 of Onaka controls the output power and wavelength of each of the four excitation light sources 81, 82, 85, and 86, instead of a plurality of different radiation wavelengths produced by a single laser pump source. Onaka fails to teach or suggest independently adjust power control of each of a plurality of different radiation wavelengths of the wideband pump radiation signal produced by a single laser pump source.

Thus, Applicants respectfully submit that claims 1-10 are patentable over Onaka.

Claim 11 recites a method of providing a wide bandwidth Raman amplifier including a step of producing from a pump laser source a wideband pump radiation signal. Claim 12 recites a wide bandwidth Raman amplifier including means for independently adjusting the magnitudes of a plurality of different wavelength components of a wideband pump radiation signal. Thus, Applicants submit that claims 11 and 12 are patentable over Onaka.

3. Evans

Evans provides an amplifier system with distributed and discrete Raman fiber amplifiers. In the embodiment shown in Fig. 1 of Evans, a 1450 pump 22 provides counter propagating pump light to both a dispersion compensating fiber (DCF) 18 and a distributed Raman fiber amplifier 12. Additional pumps 22A may be utilized to provide more pump power (Evans, col. 4, lines 10-25). The embodiment shown in Fig. 4 of Evans utilizes two sets of pumps 22A and 22B, wherein 22A is being shared by the distributed Raman fiber amplifier 12 and the discrete Raman fiber amplifier 14. The other pump 22B supplies pump light to the distributed Raman amplifier 12. This configuration provides more pumping power to the amplifier system 10 (Evans, col. 4, lines 47-58). Evans only mentions that the pump signal is in the 1400 nm to 1500 nm range (Evans, col. 3, lines 60-61). However, Evans does not mention whether the signals from different pumps have different wavelengths. Nor does Evans suggest in any way that the pumps are used to produce a wideband pump radiation signal. Evans pays more attention to the power of the pump signal, instead of the bandwidth of the pump signal.

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Even if assuming the Evans pumps produce a wideband pump radiation signal, Evans fails to teach or suggest independently adjusting power control of each of a plurality of different radiation wavelengths of the wideband pump radiation signal. Evans states that the amount of light provided by the pump 22 may be controlled via input and output 2% tap couplers 25A, 25B, photo diodes 26, and feedback circuit to a voltage-controlled switch coupler 24 and a variable optical attenuator VOA 26. However, there is nothing in Evans indicating that the power control of each of a plurality of different radiation wavelengths can be adjusted independently.

Further, the radiation wavelengths in Evans are from separate pumps, instead of being produced by a single laser pump source.

Thus, Applicants respectfully submit that claims 1-10 and 11-12 are patentable over Evans.

Hecht does not supply any deficiencies of Foursa, Onaka, or Evans. Thus, claims 3-4 are patentable.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

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I hereby certify that this AMENDMENT UNDER 37 C.F.R. § 1.116 is being facsimile transmitted to the U.S. Patent and Trademark Office this 1st day of February, 2005.

Mariann Tam